CLEANUP

COLLOIDAL BORESCOPE FOR GROUNDWATER FLOW CHARACTERIZATION

LEAD ACTIVITY
Southwest Division Naval Facilities Engineering Command (SWDIV)

STATUS
Active

MISSION
Provide groundwater velocity and direction data using in situ technologies

REQUIREMENT
Monitoring wells located throughout Navy sites are used to determine certain groundwater characteristics, such as extent and amount of contamination, flow direction, and flow rate. The use of an in situ technology could provide a direct means of accurately determining groundwater flow direction and rate in a cost-effective manner. This technology could be used at various Navy stations where monitoring wells have been installed using as little as one well.

DESCRIPTION
The colloidal borescope provides direct, in situ field measurement of the groundwater velocity in a well. The colloidal borescope developed by Oak Ridge National Laboratory's Environmental Technology Section (ORNL/ETS) consists of a set of lenses and miniature video cameras capable of observing natural particles in monitoring wells. Based on field observations of these particles, in situ groundwater velocity and flow direction in a well can be measured.

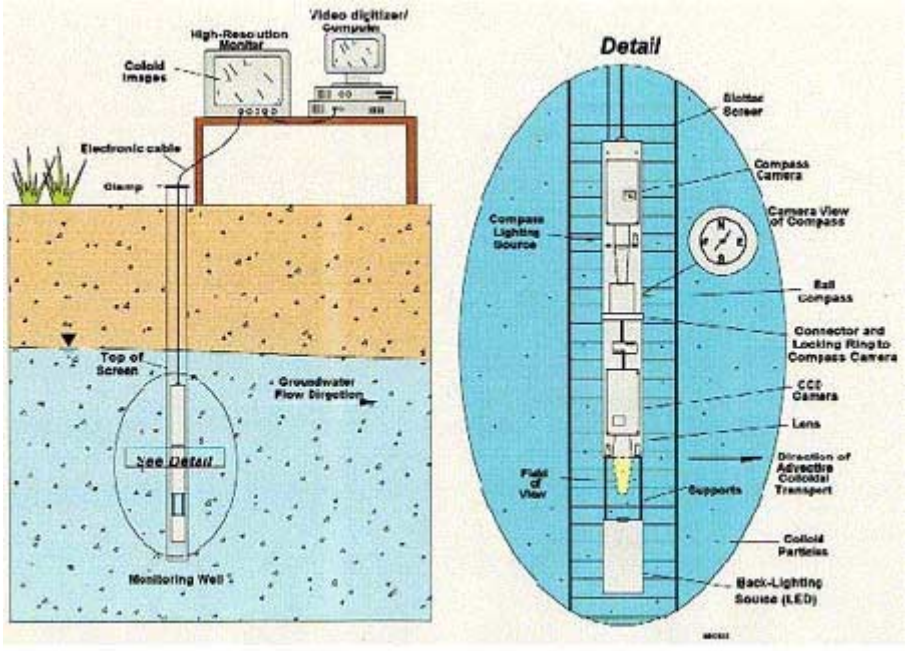

Colloidal Borescope

The colloidal borescope consists of two CCD (charge-couple device) cameras, a ball compass, an optical magnification lens, an illumination source, and stainless steel housing. Upon insertion into a well, an electronic image magnified 140 times is transmitted to the surface, where it is viewed and analyzed. The compass is viewed by one of the CCD cameras to align the borescope in the well. As particles pass beneath the lens, the back lighting source illuminates the particle (similar to a conventional microscope with a lighted stage). A video frame grabber digitizes individual video frames at intervals selected by the operator. The software compares the two digitized video frames,

matches particles from the two images, and assigns pixel addresses to the particles. Using this information, the software program computes and records the average particle size, number of particles, speed, and direction. A computer can analyze flow measurements every four seconds resulting in a large database after only a few minutes of observations.

An investigation conducted at Naval Air Station (NAS) North Island Site 9 during October 1997 measured groundwater velocities in five wells. A reliable flow rate was recorded in one of the five wells while the remaining flow rates taken at various intervals in the other test wells did not yield a reliable flow measurement. ORNL believes that several factors were responsible for this unreliability in measurements (for example, vertical flow and clogged well screens), and that with some equipment modifications and redevelopment of the existing wells it would be possible to obtain reliable flow measurements using the colloidal borescope.

Due to the limited results of the earlier colloidal borescope investigation, several additional wells at NAS North Island Sites 5 and 9 were selected and tested using the instrument in March 1998. Reliable flow zones were found in two of the additional wells. Both wells showed a west-southwest flow direction that was consistent with earlier observations.



Schematic of Colloidal Borescope

BENEFITS

- Existing monitoring wells are use for assessment, thus avoiding the cost of additional well installation
- More data may be collected in a shorter period of time
- Groundwater modeling can be validated by conducting several measurements at the site

ACCOMPLISHMENTS/CURRENT STATUS

Date	Activity
MAY 1997	Oakridge National Laboratory prepared proposal
OCT 1997	Work Plan completed. Demonstration conducted at Site 9
MAR 1998	Investigation conducted at Sites 5 and 9
APR 1999	Initiate Colloidal Borescope work at Sites 1,5,9,10 and 11

FUTURE PLAN OF ACTION & MILESTONES

Date	Activity
Ongoing	Continue to use Colloidal Borescope at other IR Sites

COLLABORATION/TECHNOLOGY TRANSFER

ORNL provided the Colloidal Borescope for the field analysis at NAS North Island. Because of its success, the technology will be implemented at other NAS North Island Installation Restoration (IR) sites.

BIBLIOGRAPHY

- Oak Ridge National Laboratory Colloidal Borescope for Groundwater Flow Characterization at NAS North Island, Site 9. 1997.Oak Ridge National Laboratory, Environmental Technology Section, ETS, Colloidal Borescope.

RELATED GOVERNMENT INTERNET SITES

ORNL ETS Colloidal Borescope

RELATED NAVY GUIDEBOOK REQUIREMENTS

Not applicable

Updated: 01/23/02